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ABSTRACT

The series of studies discussed here was designed to provide an extensive investigation into the hypothesis that reading disabilities and deficits in selective attention are related. Three studies were carried out on three different groups of children from first grade through sixth grade, and five different tasks were employed. Subjects were selected from a group of boys diagnosed as reading-disabled. IQs and scores on a standardized test of reading achievement were used as a basis for further selection. Controls were obtained from subjects' classrooms and the same exclusionary criteria were applied. The tasks used in the studies were among those previously used to measure the development of selective attention: visual and auditory forms of a central-incidental learning task, a choice reaction time classification task, a dichotic listening task and a short-term memory task with distraction. As a whole, the results appear to demonstrate that children who are poor readers are not more distractible than and do not have deficits in selective attention relative to comparison children. These studies examined averaged group effects. Individual differences should be studied as well as group means in order to further understanding of reading disability. (Author/RH)

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Selective Attention Deficits and Distractibility in Reading-disabled Children: Recent Data and Reanalysis*

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Selective Attention Deficits and Distractibility in Reading-disabled Children: Recent Data and Reanalysis

In recent years interest has grown in the relationship between selective attention, the organism's ability to select information, and reading disabilities (e.g., Ross, 1976). This interest has arisen for several reasons. First, it is commonly accepted that poor readers are more distractible in learning settings than are comparison children. In addition, the ability to attend selectively is considered to be a prerequisite for perceptual learning, a process thought to be especially important in the early stages of reading acquisition (Gibson & Levin, 1976). Finally, reading disability is often conceptualized as a lag in the development of a cognitive ability, and because a number of studies have shown that selectivity increases with age, it might be postulated that selection is the cognitive ability in which development lags, thus preventing the acquisition of normal reading skills.

Several preliminary studies appeared to offer support for the hypothesis that reading disabilities and deficient selective attention are linked (e.g., Denny, 1974; Hallahan, Kauffman & Ball, 1973; Santostefano, Rutledge & Randall, 1965). Each of these studies, however, suffered from one or more difficulties that limited the validity of its results. The series of studies discussed here (Pelham & Ross, 1977; Pelham in press; Ford, Pelham & Ross, Note 1) was designed to provide an extensive investigation into the hypothesis that reading disabilities and deficits in selective attention are related. Three studies were carried out on three different populations of children ranging from first to sixth grade, and a total of five different tasks were employed. Although some of the results could have been interpreted in isolation as supporting the experimental hypothesis, as a whole the results appear to demonstrate that

children who are poor readers are not more distractible than and do not have deficits in selective attention relative to comparison children. I shall describe the studies and their results with an emphasis on the procedural and methodological aspects of the research program which enabled us to reach out conclusions with a substantial degree of conviction. In addition to the study of reading disabilities, these points have numerous implications for studies which have used the same tasks to measure the development of selective attention in normal populations.

Beginning with subject selection, samples were selected in the same fashion for each study. Boys diagnosed as reading-disabled were referred by remedial reading specialists in a large school district. Referred boys were excluded if they had IQ scores below 80, uncorrected problems in vision or hearing or evidence of organic brain damage. Remaining children were included if their scores on a standardized test of reading achievement placed them below the thirtieth percentile on the test norms. Comparison boys matched for age were selected from the same classrooms as the referred boys and the same exclusionary criteria were applied. Comparison boys were included only if their reading achievement scores were above the fiftieth percentile. The mean percentile reading scores for poor reader and control groups were 18 and 75, respectively. There were always group differences in IQ between poor readers and controls, with the controls generally obtaining scores 10 to 12 points higher than poor readers. All statistical analyses were thus carried out using both analyses of covariance with IQ as the covariate and analyses of variance. There were, however, no differences between the two sets of results on any measures.

The tasks used in the studies were selected from those which had been used to measure the development of selective attention. The first study employed the central-incidental learning task studied extensively by Hagen and Hale (1973). This task consists of two parts, a central task and an incidental task. In sequential trials subjects are shown briefly displays containing pairs of relevant and irrelevant pictures which change spatial location over trials. The

central task is a short-term memory task in which the subject is asked for the location of a different relevant stimulus (a probe) on each trial. After a number of such trials, the subject is asked to match each irrelevant stimulus with the relevant stimulus with which it was always paired in the central task. A central score, the number of correct responses to central task probes, and an incidental score, the number of correct pairings of relevant and irrelevant stimuli, are computed for each subject. A developmental pattern of increasing central score but unchanging incidental score over age has been interpreted as reflecting the development of selective attention. A similar pattern with increasing reading ability could therefore be interpreted as evidence for deficits in selectivity on the part of poor readers. In the first study, first, third and fifth grade poor readers and controls were compared on this task. Results revealed that poor readers obtained nonsignificantly lower central scores and significantly higher incidental scores than comparison controls. Although these results were discrepant with the pattern obtained in developmental studies--higher central but nonsignificantly lower incidental scores for older children--they were nonetheless interpreted as reflecting poor reader deficits in selective attention. Our astute experimenter in this study, however, noticed a behavior pattern in the children that caused us some concern because it could have resulted in the incidental score differences we obtained and it was unrelated to group differences in selectivity. Specifically our experimenter noticed that children who had not responded correctly on a central task trial were more likely than those who had responded correctly to scan the stimulus display when it was reexposed for feedback. We decided that some of the incidental learning may have been occurring during feedback reexposure rather than during initial exposure of the stimulus display. Subsequent testing with a large group of third graders revealed that this was the case. Compared to a condition in which the display was not reexposed for feedback, incidental learning increased 15% to 50% depending on the length of the feedback reexposure period. Because we were interested in

incidental learning that had occurred when the central stimuli were present, we modified the traditional procedure in the task by eliminating the feedback reexposure period in the second study.

The second study expanded on the first by including three additional tasks chosen to measure the development of selectivity. One task was a choice reaction time classification task in which the presence of irrelevant information in a visual display was varied. This task used stimuli reported in a study by Strutt et al. (1975) in JECP, which showed that older children were less distracted than younger children by the presence of irrelevant information. A second task was an auditory version of the visual central-incidental learning task described above. Developmental patterns on this task similar to those reported on the visual task were reported by Hallahan et al. (1974) in JECP. Finally, another auditory task, a dichotic listening task, was employed. Dichotic listening tasks have also been used to trace the development of selectivity in normal populations. The one we used was adapted from one used by Treisman and Riley (1969).

The performance of poor readers and controls from second, fourth and sixth grades were compared on the four tasks. There were no group differences on either portion of the visual central-incidental learning task, suggesting that the results in the first study had been an artifact of procedure rather than a result of group differences in selective attention. On the auditory central-incidental task, poor readers performed more poorly than controls on the central but not the incidental task. Analyses of performance in the central portions of both the auditory and visual tasks showed that stimulus position and list length affected group differences in the tasks. Because such variables are known to affect short-term memory and mnemonic strategies, these data raise the possibility that developmental changes in the central portion of the tasks are not a result of developing selective attention. Instead, I should argue that the developmental pattern which has been reported on both tasks--increasing central but unchanging incidental scores--is more parsimoniously interpreted as reflecting the

development of mnemonic skills which influence central task performance but the absence of a change in selective attention reflected in an amount of incidental learning which does not change over age. I shall return to this point shortly when I describe the third experiment, which studies in more detail the auditory central task.

In the choice RT task in which the presence of irrelevant visual information was varied, poor readers exhibited a significantly slower rate of information processing, measured in bits of information transmitted per second, than controls, but this difference in rate was not affected by distraction. In addition, there were no interactions between group reading group and the variables of age and dimension. In contrast to the reading group effects, however, both dimensional characteristics and distraction changed over age, indicating that the task picked up developmental differences in the extent to which the irrelevant information disrupted performance. These results suggest clearly that the source of the poor reader-control differences on this task is not the same as the source of the normal developmental differences, presumably selective attention.

The fourth task employed in this study was the dichotic listening task. Stimuli were presented in a number of conditions in the dichotic listening task in order that the effects of several variables could be investigated. Children shadowed lists of digits under several conditions: between subject variables were age, reading group and shadowed ear, left or right; within subject variables were the speed of digit presentation, 1 digit per .67 sec or 1.0 sec, and the presence of distraction, competing digits presented dichotically in the to-be-ignored ear. The dependent measure was the percentage of digits correctly shadowed from the to-be-attended ear. Results showed that poor readers performed more poorly than controls in a variety of conditions in the task. Because the overall group X distraction interaction, however, was not significant, there was no evidence that poor readers were generally more distractible than controls. Although a significant 5-way interaction showed that poor readers' performance was affected by various

combinations of the independent variables, the pattern of results obtained was not readily interpretable as reflecting poor reader deficits in selectivity.

In addition to failing to provide support for the hypothesis that poor readers have deficits in selective attention, this second study failed to provide support for the construct of selective attention, insofar as it is reflected in the four tasks employed. The intercorrelations between residualized gain scores derived for each subject on each task ranged from .01 to .16. Before the argument is raised that unreliability may have attenuated these correlations, I should note that residualized gain scores are more reliable than simple difference scores. To be certain that this was not a problem, we computed reliabilities for the gain scores and from these the theoretical ceilings on the correlations between the tasks. The theoretical ceilings ranged from .17 to .46. In only one case, the correlation between the dichotic listening task and the choice RT task, was the computed correlation, .13, close to its theoretical ceiling, .17. Interpretation of this one correlation is thus difficult (though it may simply reflect a relationship between performance on two tasks involving speed). On the whole, however, the study provided little support for the notion that these four tasks measure the same cognitive construct. It is clear that developmental improvement in performance on all four tasks cannot be interpreted as a result of improvement in selective attention, as it has been in the literature on cognitive development. There is a need to develop a more precise meaning of selective attention by identifying a more circumscribed set of defining operations. Some especially interesting ideas along these lines were presented in a Psychological Review paper by Shiffrin and Schneider (1977). Exploration of their ideas with children might provide more precise and thus more useful information regarding the development of the construct of attention.

The final study in the series was designed to examine more carefully the variables affecting performance on the auditory central-incidental learning task described above. The reading-group differences found on that task-- higher central

scores for controls but no group differences on the incidental task-- were similar to the developmental results which have been interpreted as evidence for the development of selectivity, and they could have been similarly interpreted. In addition, however, as noted briefly above the results could also have been interpreted as reflecting poor reader difficulties in some other aspect of processing involved in performance on a short-term memory task. The first part of this study was thus designed to separate directly the selective attention and short-term memory interpretations of poor reader performance deficits in the auditory central task. Accordingly, children were presented with two task conditions. The first was a no-distraction condition in which animal names were presented in lists ranging in length from four to six words. The second was a short-term memory task with distraction, equivalent to the central task in the auditory central-incidental learning paradigm. In this condition each animal name was paired with and immediately followed by an irrelevant word, a household object, thus forming word pairs which were presented in lists varying from three to five pairs in length. Rate of presentation was also varied. Crossed with distraction, words and word pairs were presented slowly (2 sec between) or quickly (1 sec between). If the attentional explanation of earlier results with this paradigm is correct, then distraction should interact with reading ability and group differences should appear primarily under distraction conditions. If poor readers have problems in other areas of cognitive processing, however, group differences might be found under both distraction and no-distraction conditions.

Before getting to the results, the statistical analyses, which are unusual, need to be discussed. Different list lengths and rates of presentation were used in order to control for probable differences in discriminability between distraction conditions. In their studies of cognitive deficit in schizophrenia, Chapman and Chapman (1974) have shown that group X distraction interactions can arise when there are different levels of discriminating power between distraction tasks <u>even though</u> there are <u>no</u> true differential group effects.

Their research has demonstrated that in order to interpret distraction/no-distraction differences as reflecting effects of distraction per se rather than differences in task difficulty, conditions of equal discriminating power must be compared. This argument may also be applied when considering group differences in other task variables, such as speed and list length. Thus the effects of the present three task variables were examined by computing the true score variance, the best index of task discriminating power (Lord & Novick, 1968), for each list length at each speed in both distraction and no-distraction conditions. The ratio of true score variances was then computed for each possible pairwise comparison of conditions; a ratio of .67 or greater was selected as the criterion for identifying conditions which were closely matched in discriminating power. Closely matched conditions were compared in 2 (task condition) X 2 (reading ability) ANOVAs. It should be noted that this method of analysis involves comparisons in which the task variables may be confounded. Since the main question of this experiment concerns possible differential reading group effects of distraction, the comparisons involving distraction were of primary importance. The attentional interpretation of poor readers' task deficits would be supported by the presence of a group X distraction interaction in analyses comparing distraction and no-distraction conditions. In the absence of an interaction, however, a main effect of reading group, demonstrating poor reader deficits under both distraction conditions, would suggest that poor readers' processing deficits arise in some processing stage other than selective attention.

Results of these analyses revealed that poor readers consistently obtained lower scores than control children, with the main effect of reading ability reaching significance in 18 of 19 comparisons involving conditions of closely-matched discriminating power (19 of 66 possible comparisons were closely matched in true score variance). The task variables also showed a consistent effect on

performance, with distraction and/or speed and/or list length resulting in significantly depressed scores for all children in 15 of the 19 comparisons.

In contrast to main effects, there were very few significant interactions obtained in the comparisons. In only two conditions was there a significant interaction with reading group and neither of these involved distraction. When difficulty levels were matched to obtain appropriate comparison conditions, then, poor readers were no more affected by distraction than were controls. In addition, poor readers showed performance deficits in many conditions which did not involve distracting stimuli. These results demonstrate clearly that performance on the central portion of the auditory central-incidental task is not a result of poor selective attention or greater distractibility in poor readers.

This last study also investigated group differences in the use of mnemonic strategies in this task and how they were affected by manipulated variables and a training procedure. Time does not allow any explanation other than the brief statement that poor readers were less likely than controls to use rehearsal, but a training procedure benefited controls as much as poor readers and did not eliminate differences between the groups. These results suggested to us that deficits in the use of active cognitive strategies appear to be <u>symptoms</u> rather than <u>causes</u> or <u>explanations</u> of reading difficulties. Training in appropriate mnemonic strategies may not eliminate poor reader-normal differences because a more basic underlying processing problem interferes with memorial strategies in the same way that it interferes with reading itself.

The results of all three studies taken as a whole suggest to us that poor readers have difficulties in conditions including but not limited to those involving distraction and the need to attend selectively. Our current research is focusing (no pun intended) on the notions of attentional capacity and automaticity in processing as they might be related to reading ability. It might be worth noting at this point that the notion of a poor reader deficit in selective attention can

be retained if, following Shiffrin and Schneider (1977) divided attention is considered to be a type of selective attention.

In closing, I should like to note that reading disability is no doubt a disorder with a variety of causes. In all of these studies we have examined averaged group effects. It is certainly possible that some children who are poor readers do have problems in selective attention, for example, those who have a concurrent diagnosis of attentional deficit disorder with or without hyperactivity. In the second study I discussed, we tried to look at patterns of performance for individual subjects across the four tasks, but we were unable to identify any subgroup of poor readers who had similar patterns of deficit across the four tasks. This may have been a function of a relatively small N, 60. Future investigators would be providing much needed information if they were to use clustering procedures to identify homogeneous subgroups of poor readers and correlated differential patterns of cognitive performance. Until we begin to study individual differences was well as group means, I do not believe that we shall be successful in our attempts to understand reading disability.

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Reference Notes

1. Ford, C., Pelham, W. & Ross, A. The role of selective attention and rehearsal in the auditory short-term memory performance of poor and normal readers. Manuscript submitted for publication December, 1978. Copies may be obtained from the second author at the Department of Psychology, Washington State University, Pullman, WA 99164.